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UNITED STATES DEPARTMENT OF AGRICULTURE

FOREST SERVICE

FINAL REPORT

EPIDEMIC OF THE PINE BARK BEETLE, *DENDROCTONUS FRONTALIS* ZIMM.
IN HONDURAS

by

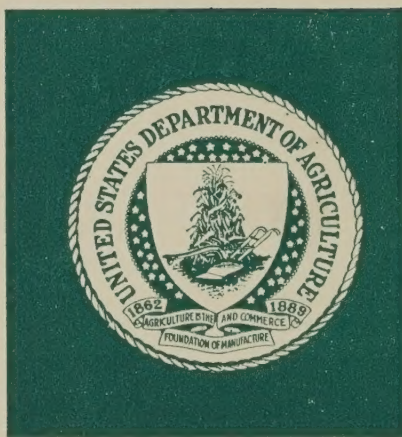
David E. Ketcham and Wm. H. Bennett



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SUMMARY

Potentially valuable pine stands in northeastern Honduras are seriously threatened by an epidemic of the bark beetle, Dendroctonus frontalis. Within a year the insect has destroyed an estimated 1 billion board feet of timber over an area of 6.3 million acres. All of the infested trees are infected with blue staining fungi, and most are undergoing rapid deterioration by decay organisms and wood-boring insects.

The beetle population is increasing sixfold per month, and there is no evidence that natural factors - such as parasites, predators, and disease - will reduce the outbreak in the immediate future.

Infestations typically occur in rocky mountain ridges and steep slopes that have been burned over for decades. Affected trees often are over 100 years of age with negligible growth in recent years. The repeated fires have left extensive stands of pure pine consisting of widely spaced trees and no reproduction. As a result, soils have become depleted, shallow, and subject to erosion.

Due to the magnitude of the epidemic, the rapid development of the beetle, lack of roads, manpower, and financing; direct control on an area-wide basis is impractical. However, success may be possible if fast and vigorous action is taken to suppress the insect on individual segments of the infestation area. Each of these zones must be of sufficient size to prevent rapid reinvasion from adjacent, uncontrolled areas. After control is completed in one zone, control crews should move to the next. A small maintenance force, however, must remain in each zone to suppress spot infestations that reappear.

The recommended control for the beetle is to cut infested trees and spray the bark with a 0.5-percent benzene hexachloride (BHC) diesel oil solution. Since many infestations are inaccessible by road but in the vicinity of streams, studies should be undertaken to determine the feasibility of substituting water for oil as a carrier for BHC. In either case, the direct application of the spray to infested bark should not adversely affect fish, wildlife, or other resources.



FINAL REPORT

EPIDEMIC OF THE PINE BARK BEETLE, DENDROCTONUS FRONTALIS ZIMM. IN HONDURAS

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David E. Ketcham and Wm. H. Bennett

INTRODUCTION

The bark beetle, Dendroctonus frontalis Zimm., formerly known as D. mexicanus Hopk., is currently epidemic in the pine stands of north-eastern Honduras. The outbreak was first noticed in April 1963 in the San Esteban-Gualaco area, Department of Olancho. Since this time, the epidemic has developed rapidly and extensively and has reached catastrophic proportions. A similar, but much less severe outbreak, was reported in the Olancho mountains in 1939, but it reportedly declined to an endemic level one year later. Elderly natives in this area stated that they have sometimes observed small groups of dead trees on mountainsides surrounding their villages, but never have they seen such spectacular timber mortality as now occurs.

Timber is potentially one of the most valuable resources in Honduras. Although the timber industry is relatively undeveloped, sawtimber products are currently the third most important export. An estimated 100 sawmills are currently operating in the Olancho area, and at least one large American firm has seriously been considering establishing a pulp mill there.

The U. S. Department of Agriculture, Forest Service, was asked by A.I.D. to provide two forest entomologists to appraise the epidemic and to provide technical information and advice to Honduran officials, as requested. David E. Ketcham, Insect and Disease Control Branch, Division of State and Private Forestry, Region 8, and William H. Bennett, Division of Forest Insect Research, Alexandria, Louisiana, arrived at Tegucigalpa, Honduras, on February 5, 1964. During the following weeks, they made aerial surveys and ground inspections of infested spots throughout the affected area. They were accompanied by Alberto D. Banegas and Mario R. Morillo, entomologists, Ministry of Natural Resources, Honduras.

TECHNICAL INFORMATION

Causal agent.--Dendroctonus frontalis Zimm. (= mexicanus Hopk.).

Host trees.--Pinus oocarpa, P. caribaea, and P. pseudostrobus. P. oocarpa is the most common tree in the area and the most frequently attacked by the beetle.

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INFORMATION

The First National Bank of the United States is a corporation organized under the laws of the State of New York. It is a member of the Federal Reserve System and is authorized to do a full banking business. The bank is located at 100 Wall Street, New York City, and has branches in various parts of the United States. The bank is owned by its stockholders, who are entitled to dividends and to elect directors. The bank is managed by its officers, who are elected by the stockholders. The bank is subject to the supervision of the Federal Reserve Board and the State Banking Department. The bank is a member of the American Bankers Association and the National Automated Clearing House Association.

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Type of damage.--The adults of D. frontalis normally attack the bole of standing trees in great numbers where they construct "S"-shaped tunnels in the growing tissue between the bark and the wood, thus girdling the tree. The adult beetles also carry blue staining fungi, Ceratocystis spp., which spread into the sapwood and assist in killing the tree. Lumber cut from infested trees is degraded because of the presence of the fungus. After the tree has been killed, numerous secondary wood-boring insects and decay fungi cause the trees to deteriorate rapidly, making the wood unusable for most commercial purposes at the end of a 2- to 3-month period.

Biological information.--Indications are that the life cycle of D. frontalis in Honduras is about 1 month, or approximately the same as in the southern United States. Because of the year-around, mild weather in Honduras, there may be 11 or 12 generations per year. Broods overlap in their development, and all stages may be found at anytime. Rough counts of beetle exit holes and entrance holes in the bark showed an average ratio of approximately 6 offspring to each parent. Natural enemies of the beetle - such as parasites, predators, and diseases - were present but were of minor importance. Predaceous pseudoscorpions, ostomid and clerid beetles, and sucking insects were present in most of the infested trees. Also, small parasitic wasps and flies were occasionally found. All of these organisms, however, were in immature stages of development and could not be identified to species. Ips spp. were rarely found to be associated with D. frontalis in standing trees. Ips spp. collected earlier from this area had been identified as I. cribricollis (Eichh.), I. interstitialis (Eichh.), and I. lecontei Swaine. Pine sawyers, Monochamus spp., ambrosia beetles, Platypus spp., and subterranean termites also were common.

Pattern of attack.--The beetle attacks typically started at about 6 to 10 feet above the ground and extended into the top and branches to a diameter of 2 to 3 inches. Within this area of attack, the lower 4 to 6 feet showed large, conspicuous white pitch tubes - 1 inch to 1.5 inches in length - where the beetles had failed to become established (pitch-outs). Above this area, however, smaller pitch tubes containing red boring dust indicated successful attacks. Brood survival was high in the upper portion of the tree.

Environmental factors.--Most of the infestations were on rocky mountain ridges and steep slopes that had been repeatedly burned over by fire. The stands were typically pure pine and consisted of widely spaced trees growing on shallow, depleted, and superficially eroded soils. The repeated fires had caused deep catfaces on many of the standing trees. Many of the trees examined were over 100 years old and were approaching overmaturity. Growth within the past 10 years was slight. Trees growing under these conditions are normally highly susceptible to attack by D. frontalis. Long-term weather records indicate that air temperatures within the epidemic area range between 70 and 80 degrees Fahrenheit year-around with occasional nighttime lows in November

and December of 45 to 50 degrees Fahrenheit. These temperatures are well within the optimum range for rapid beetle development and subsequent population buildup.

Location and intensity of outbreak.--The epidemic is located in the primary pine-producing region in Honduras (figure 1). An estimated 6.3 million acres are currently infested in Atlántida, Colón, El Paraíso, Francisco Morazán, Olancho, and Yoro Departments; and the epidemic appears to be spreading rapidly to the west and south. Large, new-spot infestations containing up to several hundred infested trees each are appearing daily. Recent reports to the F.A.O. indicated that the infestations have crossed the Nicaraguan border southeast of Santa María. The hardwood forests along the northern coast and the extensive rain forest to the east will limit further spread of the epidemic in these directions. No estimate of the number of currently infested trees was made due to the lack of adequate maps of the epidemic area. However, hundreds of active spot infestations containing thousands of infested trees were observed during reconnaissance flights and ground-checks. Based on the size of the epidemic area and the number of trees killed, the volume loss since the beginning of the epidemic probably exceeds 1 billion board feet.

DISCUSSION

The current epidemic of D. frontalis in northeastern Honduras is spreading rapidly. The mild climate is ideal for rapid population buildups, and there is an abundance of susceptible host material. If no attempt is made to suppress the insect, continued heavy losses should be expected. It is possible that natural enemies or other factors may cause a decline in the epidemic within the next year, but there is no evidence of this possibility at the present time. If the insect should continue to spread for the next several years, the pine timber resource may be almost completely destroyed. In addition, loss of the seed source and the destruction of existing seedlings by annual burning will prevent natural regeneration of the stands.

The natural enemies of D. frontalis in Honduras appeared to be similar to those in the United States. Unfortunately, they were few in number, and many months may elapse before these organisms reach a satisfactory level of effectiveness.

Basic and long-range studies to evaluate the importance of different insect and mite parasites and predators and to develop methods of rearing them in large numbers have been started in the United States. Studies of a clerid predator, Thanasimus dubius Fab. for example, show that the larvae search out and destroy large numbers of D. frontalis

1. The first part of the paper discusses the importance of the study and the objectives of the research.

2. The second part of the paper describes the methodology used in the study, including the data collection and analysis techniques.

3. The third part of the paper presents the results of the study, including the findings and conclusions.

4. The fourth part of the paper discusses the implications of the study and the future research directions.

5. The fifth part of the paper provides a summary of the study and the key findings.



Figure 1. Location of *Dendroctonus frontalis* infestation.

larvae in inner-bark tunnels. Clerid adults also are predaceous and pounce upon and devour bark beetles as they attempt to enter the tree. Under caged conditions, a ratio of 1 clerid to 20 bark beetles will reduce populations about one-third. Theoretically, it would require 3 clerids per 20 bark beetles to provide 100-percent control. Such a density is probably never realized in nature, but further basic biological and ecological studies may show ways of increasing populations of this useful insect.

Undoubtedly, the same or closely related species of parasites and predators in the United States are associated with the bark beetle in Honduras, but considerable research will be necessary to find out if this is so. If the Honduran parasites and predators of D. frontalis are found to be different species from those in the United States, an energetic and concentrated research approach would be necessary before introductions could be made with safety. Ideally, the complete life history of the organism, its reaction to the physical habitat, and its ecological relationships with other organisms should be known before it is released. There is always the risk of admitting species that are less effective than those already present. Once established, a parasite or predator may destroy native ones that are more beneficial or starve them out through vigorous competition. Thus, unless introductions are made with great care and with a sound biological and ecological understanding of the requirements and habits of the organism, a serious mistake may be made which may result in a permanent biotic change in favor of the bark beetle. Therefore, there is little possibility of using biological agents to suppress the epidemic at this time.

New-spot infestations containing several hundred infested trees each are appearing daily. The decision to control a dynamic insect like D. frontalis after the population is so high and distributed over 6.3 million acres of relatively inaccessible area should be made only after a thorough evaluation of the facts and careful consideration of the alternatives. It will be very difficult to organize, manage, finance, or maintain a control force necessary to be successful under these conditions.

The Honduran Government, however, already has made a decision to attempt to control the epidemic. If the control effort over the entire epidemic area is to have any chance for success, all of the existing infested trees must be located and treated within a 2- to 3-week period. Otherwise, due to the reproductive capacity of the insect and its short life cycle, populations will continue to increase. However, the outbreak now covers approximately 6.3 million acres. To treat every infested tree over the entire area would be impossible with the money and manpower available.

An alternative method would be to divide the epidemic area into control zones that can be treated within the required time limit. These

zones must be of sufficient size to prevent rapid re-infestation from adjacent, uncontrolled areas. After control in one zone has been completed, the main control force should move into the adjacent zone. A small maintenance force should remain to treat infestations missed in the initial effort and areas that become re-infested. This procedure should be continued until the entire epidemic area has been treated or until natural factors reduce the populations in the untreated areas to an endemic level. This technique has been used effectively many times in the United States. In all cases, however, the epidemic area has been smaller and much more accessible.

Before the location, size, and number of control zones can be determined effectively; the following information is necessary:

1. The number and location of the infested trees.
2. The rate and direction of spread of the insect.
3. The location of natural barriers such as large openings in pure hardwood stands.

Due to the lack of adequate topographic maps, aerial photographs, and insectary facilities; it was impossible to gather this information at the time of this evaluation. However, with the necessary facilities, these data can be collected.

After control zones have been established, a well-trained control force large and mobile enough to treat all of the infested trees within the required time period must be maintained in the zones being treated. If the control effort for any reason should fall below this level or be discontinued, the bark beetle population will continue to increase and wipe out earlier accomplishments.

A need for rapid and complete control of all known infestations cannot be overemphasized. Since the major portion of the epidemic area is relatively inaccessible by motorized vehicles, the use of helicopters to transport control crews and supplies into isolated areas must be considered if all infested trees within the control area are to be treated within the required time period.

One prerequisite for a successful control operation is the accurate location of infested spots for the control crews to treat. Due to the size and nature of the epidemic area, this can be done most effectively and economically from the air by highly trained survey personnel.

In a control project such as this one, which will require considerable expenditure of money over a relatively long period of time, there is a

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definite need for continuous observation to evaluate insect population trends and the effectiveness of control. This can best be accomplished by an entomologist well trained in evaluational techniques.

The Forest Insect and Disease Control Branch of the U. S. Forest Service in the Southern Region has personnel highly trained in evaluation and survey procedures for D. frontalis as well as excellent facilities for training in these procedures. If the Honduran Ministry of Natural Resources should so desire, the Zone 3 Office of the Forest Insect and Disease Control Branch at Alexandria, Louisiana, would be happy to assist in the training of key personnel. If these personnel could be sent to the Zone 3 Office for training, they could observe and participate in surveys and evaluations currently in progress in Louisiana, Mississippi, and Texas. Current research studies on D. frontalis being conducted by the Forest Insect Laboratory in Alexandria, Louisiana, and the Boyce-Thompson Institute near Beaumont, Texas, could also be reviewed. This training could be accomplished in a 4-week period.

RESOURCE EVALUATION

Timber is one of the most important resources in Honduras. The mountainous terrain and the shallow, rocky, and eroded soils make most of the land unsuitable for other uses. Since pine timber grows extremely well in these areas and is a renewable resource, timber could become the basic industry in the Honduran economy if the forests were put under management. The timber is of excellent quality, and sawtimber products are currently the third most important export.

An inventory of the pine resources conducted in 1959-1960 by a private consulting firm over about 2.5 million acres of the epidemic area showed that the stands contained an average of 7,044 board feet or 22.6 standard cords (128 cubic feet) per acre. Diameter at breast height (4.5 feet above the ground) of the trees measured ranged from 4 to 46 inches and averaged from 15 to 20 inches. Average tree heights ranged from 116 feet in the northern part of the epidemic area to 83 feet in the southwestern part. Most of the stands were approaching overmaturity and were growing at a rate of about 100 to 120 board feet per acre per year. Although pine trees are scattered over almost the entire area, the commercially valuable stands are concentrated on an estimated 62.4 percent.

Using the average volume figures developed by the private consulting firm, the 6.3 million acres currently infested by D. frontalis include approximately 3.9 million acres of commercially valuable timber stands or 27.8 billion board feet of pine sawtimber. Including tops and trees less than 14 inches in diameter, total pine volume would equal about 89.2 million standard cords.

All of the pine timber within the epidemic area is immediately threatened by D. frontalis. An estimated 1 billion board feet of pine timber have been killed since April 1963. If the epidemic should continue to spread at its current rate, the insect would pose a serious threat to all the commercially valuable pine timber stands throughout the Central America area.

In the Gualaco-San Esteban area, the insect has killed about 100 percent of the pine timber on whole mountainsides. Due to the indiscriminate burning which annually kills all of the existing pine seedlings, these stands will not be regenerated naturally. As a result, the soils will continue to be eroded by the wind and the rain. Severe flooding due to rapid runoff of water from these denuded areas during the rainy season might also occur which would not only threaten the agricultural regions along the major streams but also the people living within these areas.

IMPACT OF CONTROL ON OTHER RESOURCES

The direct application of a 0.5-percent solution of gamma BHC in diesel oil to the infested portion of the trees should have no adverse effect on fish, wildlife, or other resources.

RECOMMENDATIONS

1. Obtain suitable maps or aerial photographs with a scale of not less than 1 to 50,000 of the epidemic area.
2. Train key personnel in evaluational and survey techniques. These personnel should preferably have a basic entomological background and a knowledge of photo-interpretation. This training could be best accomplished in the United States by the Forest Insect and Disease Control Branch, Region 8, U. S. Forest Service.
3. Make an intensive survey utilizing the sampling technique designed for Dendroctonus frontalis in the United States to obtain an estimate of the total number of infested trees and their distribution.
4. Determine the parent adult to brood ratio so that the rate of increase of insect populations can be estimated.
5. After reviewing the information obtained from the procedures suggested in Recommendations 3 and 4, carefully consider the chances for success of and the cost of an all-out control project. In the United States, control costs range from \$2 to \$3 per tree.
6. If the control project can be economically justified after considering the alternatives and has a good chance for success, divide the epidemic area into control zones as suggested under "Discussion."

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7. Develop a control plan with the assistance of a trained entomologist. A sample plan similar to those used in the United States is included in the Appendix.
8. Train field personnel in the proper control procedures. Copies of "Instructions for Control," "Instructions for Scouts," and "Safety Instructions" which are currently used in the United States are included in the Appendix.
9. Test a 1.0 percent gamma BHC water emulsion plus a wetting agent (Seven-eleven) in the field to determine its effectiveness in controlling the beetle.
10. Develop a permanent and adequate detection and control system to discover and suppress beginning outbreaks of D. frontalis (and other destructive insects) when infestations are small and easily handled. Trained key personnel, essential control equipment, and chemicals should be in constant readiness for immediate action.
11. Undertake basic research on the biology and ecology of D. frontalis in Honduras. Studies of the beetle's natural enemies and associated organisms will be involved.
12. Through forest fire research and timber management research, learn how to manage the forest resource to secure and maintain maximum stand vigor and production. Good forest management offers the best solution to permanent insect control.

A P P E N D I X

SUGGESTED CONTROL PLAN ^{1/}

DENDROCTONUS FRONTALIS CONTROL PROJECT IN HONDURAS

PURPOSE OF PROGRAM

The purpose of this program is to control as rapidly as possible D. frontalis infestations presently within an area of approximately 6.3 million acres in northeastern Honduras and to take all necessary measures to prevent further loss of timber due to attacks by this beetle. The project will include aerial surveys to locate areas of infestation and possible active brood trees. Follow-up ground-checks to verify brood trees will be made. All active brood trees will be treated in accordance with the "Instructions for Control" within a 2- to 3-week period following discovery.

OPERATIONS

Aerial survey flights will be the major means of locating and delineating infested areas. These flights will be made by trained personnel in accordance with procedures developed by the U. S. Forest Service. Control zones in which control crews are active will be flown at 2-week intervals.

Following the location of the infested areas, a map will be prepared indicating all single- and multiple-tree spots. All of the spots will then be checked by the scouts in accordance with the "Instructions for Scouts." All scouts will be trained thoroughly in identification and evaluation prior to beginning ground-checking.

Upon identification of D. frontalis brood trees, chemical treatment will be initiated. All trees containing active broods will be treated with chemical regardless of whether salvage is feasible or planned. Chemical control will be accomplished by felling and spraying trees with a 0.5-percent solution of benzene hexachloride (BHC) in diesel oil. All control operations will be done in accordance with the "Instructions for Control."

Preliminary studies in the United States indicate that a 1 percent benzene hexachloride (BHC) water emulsion plus a wetting agent may be effective in controlling D. frontalis. Under certain conditions, the

^{1/} This control plan was modified from control plans used for D. frontalis in the southern United States and is presented here for use as a guide for the Honduran control project.

PROPOSED PROGRAM

The purpose of this program is to control the spread of the disease in the community. The program will be carried out in the following manner: 1. The first step will be to identify the source of the infection. 2. The second step will be to isolate the infected individuals. 3. The third step will be to treat the infected individuals. 4. The fourth step will be to control the spread of the disease. 5. The fifth step will be to monitor the progress of the program. 6. The sixth step will be to evaluate the results of the program. 7. The seventh step will be to report the results of the program. 8. The eighth step will be to disseminate the results of the program. 9. The ninth step will be to maintain the program. 10. The tenth step will be to terminate the program.

RESULTS

The results of the program are as follows: 1. The source of the infection has been identified. 2. The infected individuals have been isolated. 3. The infected individuals have been treated. 4. The spread of the disease has been controlled. 5. The progress of the program has been monitored. 6. The results of the program have been evaluated. 7. The results of the program have been reported. 8. The results of the program have been disseminated. 9. The program has been maintained. 10. The program has been terminated.

The following table shows the results of the program: 1. The number of infected individuals has decreased. 2. The number of deaths has decreased. 3. The number of cases has decreased. 4. The number of recoveries has increased. 5. The number of relapses has decreased. 6. The number of complications has decreased. 7. The number of hospitalizations has decreased. 8. The number of consultations has decreased. 9. The number of prescriptions has decreased. 10. The number of tests has decreased.

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BHC water formulation alone may have some value; but on green or moist bark the spray tends to develop into bubbles. The wetting agent prevents this and helps to spread the emulsion into bark crevices. Also, it may increase the penetration of the emulsion into the bark and better protect the insecticide from adverse effects of rain. A thorough testing of this formulation in Honduras, particularly under wet weather conditions, may show that the water plus the wetting agent may be substituted for diesel oil in the spray mixture. If this modification can be made, there will be a substantial reduction in the cost of spray formulation and in transportation, especially in outbreak areas where water is available. Also, the risk of fire, the penetrating effects of the oil into the clothing of the spray men, and resulting irritation to the skin will be eliminated.

COORDINATION

The Project Director, working under the general direction of the Chief of State and Council of Ministers, will be responsible for the overall coordination of the project. Technical advice and guidance will be given by trained entomologists who will be serving on the Project Director's staff. Close cooperation will be required at all times between the Project Director, the Council of Ministers, and other organizations cooperating in the control effort. Formal and informal inspections of control operations will be made by the Project Director and his assistants in order to assure adequate and complete control and to determine compliance with the existing regulations and policies. The Project Director will maintain a continuing record of progress on the project and keep the Chief of State and Council of Ministers informed as to the current status of the epidemic.

RECORDS AND REPORTS

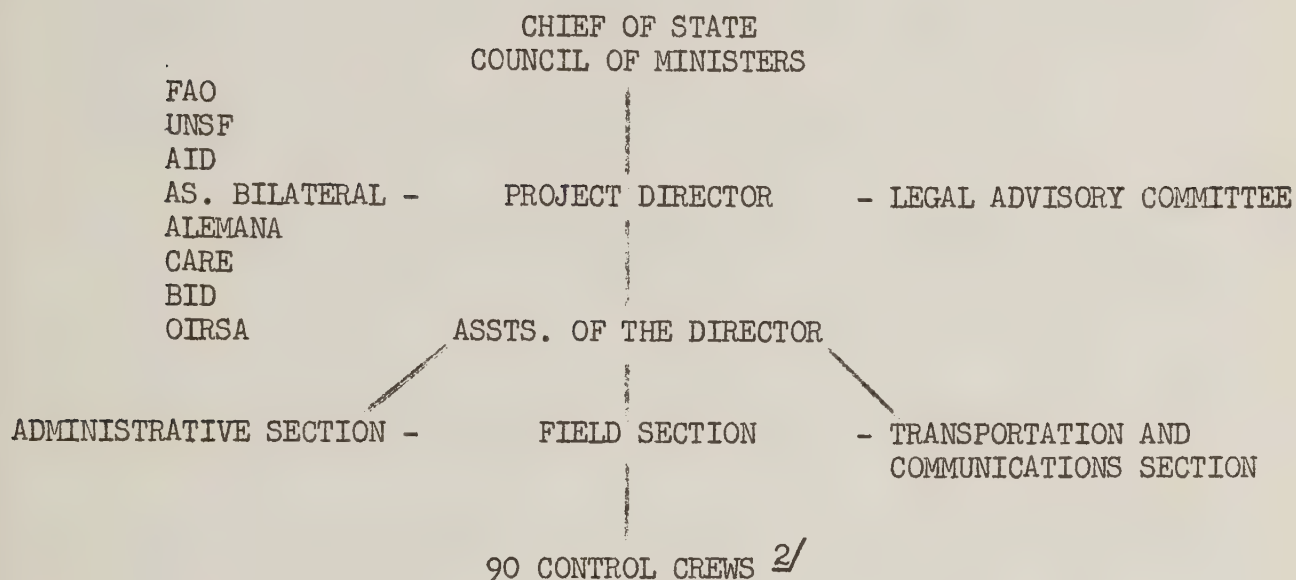
The Project Director will maintain an up-to-date progress record showing infested areas, treated areas, and other pertinent information. Reports will be submitted to the Council of Ministers and Chief of State as required.

SAFETY

Safety practices and procedures will be incorporated and followed in all phases of the control program as indicated in the "Safety Instructions."

PROPOSED ORGANIZATION CHART 1/

DENDROCTONUS FRONTALIS CONTROL PROJECT
IN HONDURAS



1/ Prepared by the Honduran Government with assistance from the F.A.O.

2/ Each crew will contain 1 crew chief, 1 power saw operator, 2 spray men, and 2 men with mules to transport equipment and insecticide.

THURSDAY
JANUARY 10, 1907

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SOUTHERN PINE BEETLE CONTROL

Instructions for Scouts

The location of infested trees is one of the most important jobs in the control of Dendroctonus frontalis. Scouts must: (1) locate the infested trees; (2) designate the trees in which beetles are still active; and (3) direct the control crews to the infested trees or spots.

How to locate and recognize infested trees and spots:

1. Crown color - most easily spotted by the presence of red-top trees, fading yellow-green trees, and recently dead trees from which needles have been shed. In most infested areas there are also beetle-attacked trees in which the top is still green with very minute evidence of attack. Generally the beetle is present and active in fading trees; it may have left the red-top or recently dead trees; all should be checked for the presence of larvae and adult beetles.
2. Locating beetle-infested trees by trunk and bark examination - After locating an infested spot, the presence of the beetle and its activity can be determined by careful trunk and bark examination.
 - a. Look for whitish "pitch tubes" on the bark; these mark the spots where the beetles attacked the tree. The first attacks may be high up, so check the entire trunk.

Use field glasses. Conspicuous, white "pitch tubes" frequently indicate the attacking beetle was "pitched out." Small white ones or tubes colored by bark particles indicate the beetle was successful.

- b. Bark dust - very fine pieces of bark may be the only sign of the beetle if attacks are high or there is too little pitch to form "pitch tubes"; look for this red dust in bark cracks, in cobwebbing, or on the ground at the base of the tree.
 - c. Check inside bark for beetle tunnels - remove bark of the tree. If winding S-shaped tunnels that frequently intersect - about 1/16-inch wide - are present, the D. frontalis beetle has attacked. You may or may not see the small beetle, its eggs, or larvae. The galleries of the D. frontalis beetle provide definite identification of cause of mortality.

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- d. Cut or break open the bark - Small, cream-colored larvae or pupae or light brown colored beetles - deep in the bark - are the new, active beetle population.
- e. Holes in the bark - This is a good indicator of beetle activity. Many holes about 1/16-inch in diameter indicate most of the brood has left; few holes indicate that the brood is still in the bark.
- f. The beetle - Look for a short legged, stout, dull to dark brown beetle about 1/8-inch long, 1/16-inch wide with a convex head visible from above, and a vertical notch or groove on the front of the head visible with a hand lens. There are many secondary beetles which look like the D. frontalis pine beetle and work along with it. Some remain after the pine beetle has gone. It is important to know the difference.
- g. Another indicator - Other wood-boring insects may attack trees infested with southern pine beetle. Evidence of this attack is cone-shaped pits about 1/4-inch in diameter in the bark. At times, this is the only indication that the tree has been attacked.

Marking Beetle Trees:

1. The scout is the man who takes the information from the flight map and goes out on the ground, locates the spots, estimates the size of the job to be done, and tags the way in for the control crews. He takes the information that he records to the Project Director, and with this information the control crews are dispatched. The scout also estimates the number of infested trees in the spot and the number of gallons of insecticide that might be required.
2. After control - Check each beetle kill to locate trees missed during first spotting or missed by control crews. This should be done within 3 weeks after control is completed.

Keeping Records:

1. Keep an up-to-date map of daily progress in spotting, including the location of infested spots. Show access routes - roads, trails, etc. - on maps for use by control crews.
2. Other records - A weekly summary of number of trees spotted and spotting costs is desirable.

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SOUTHERN PINE BEETLE CONTROL

Instructions for Control

General:

1. Contact between scouts, the control crew foreman, and the control Project Director will be maintained in order that crews may be moved from one infestation to another most effectively.
2. All spots will be thoroughly checked for infested trees.
3. All infested brood trees are to be treated.
4. Maintain progress control map showing the location of each control area and the date treatment was completed.

Chemical Treatment:

1. The infested trees should be cut cleanly and not left attached to the stump. Branches should be trimmed from the top sides of the trees and underneath only to the extent necessary. The spray should be directed to the top of the log. This permits the spray to soak in, prevents excessive dripping in contrast to application made from the underside, and provides for good penetration. The tree or logs will need to be turned twice, spraying the top third of the log each time. The spray nozzle should be held about 1 foot from the log, using a coarse, cone-shaped spray. Experience in the field has shown that spraying the underside of the log or tree even though it is raised slightly off the ground usually required a large amount of spray, and care should be exercised to see that the underside is thoroughly treated. Do not cut or treat red-topped trees that do not contain brood.
2. Chemical formulation - Mix 2 gallons of liquid benzene hexachloride concentrate (containing 11-12 percent Gamma isomer) in 50 gallons of Number 2 fuel oil or diesel fuel.
3. Fell infested pines so that tops will not overlap; this saves time in control.
4. Spray the infested portions of the trunk, stump, and all limbs to a minimum 2-inch diameter.
5. Soak the bark thoroughly until the insecticide drips.

6. Do not spray bark wet by heavy rains - Allow sufficient time for the bark to dry before spraying.
7. Designate trees treated - This is generally accomplished by marking the number and date of treatment on the stump just before trees are sprayed. This will also indicate any infested and cut trees that have been missed. The date of treatment will be of value to scouts, entomologists, or control technicians checking control operations.
8. Organize treating crews so that there is no lost motion during the treating operation. Treaters should receive a steady supply of insecticide. The trees are felled singly and are treated immediately. The practice of felling a large number of trees before treatment makes it easy for infested trees to be overlooked.
9. Keep a daily record of the number of trees treated, gallons of insecticide used, and man-hours spent on control by areas treated. Maintain a daily progress chart and map.

Locating Beetle-Infested Trees - The presence of the beetle and its activity can be determined by careful trunk and bark examination. See "Instructions for Scouts" for detail.

Control Equipment and Supplies per Crew -

1/2-ton pickup or jeep or some other form of transportation
where necessary

3-gallon air pressure handsprayers if power-driven spray
not available (2 sprayers per spray man are desirable)

power saw

cant hook

5-gallon back-pack cans

pair rubber gloves

rubber aprons

first-aid kit, including snake bite kit

portable drinking fountain

hard hats, safety glasses, shin guards

axes with sheaths, files, axe stones

[illegible]

SOUTHERN PINE BEETLE CONTROL

Safety Instructions

1. Observe fire precautions: The fuel oil insecticide solution deposited on the ground might catch fire from a lighted match or the heat of a gasoline-powered chain saw.
2. Insecticidal spray on the pine needle litter is slippery and hazardous to foot travel in sprayed areas. Walk with caution.
3. When spraying felled trees, stand upwind to avoid getting insecticidal spray in eyes and on clothing.
4. A few individuals are very susceptible to irritation by the fuel oil insecticidal spray. Crew men who develop a rash on the skin should be transferred to another position on the crew. Treaters should change into a fresh set of work clothes each day and bathe each evening. If clothing becomes wet with insecticide, remove it.
5. Keep water on hand for emergency use to wash insecticide from eyes or other parts of body. Cleaning cloths should be available at all times.
6. Keep spray equipment in good repair. Leaky spray tanks, nozzles, and hoses can be very hazardous. Use oil-resistant hose, gaskets, and other fittings.
7. Be certain all insecticides and chemicals are properly stored and labeled. If there are questions, contact the staff entomologist.
8. Only insecticides, fungicides, and herbicides specified in an approved control project will be purchased.
9. Dispose of empty insecticide containers by returning to manufacturer or by crushing and burying.

HABITS OF DENDROCTONUS FRONTALIS

The adult of D. frontalis is a tiny, shiny black or dark brown, hard-shelled beetle, about 1/8-inch long and one-third as wide. It flies to a living tree and bores into the bark of the trunk. As it enters the bark, the beetle pushes out fine reddish particles which lodge in bark crevices and at the base of the tree. This is sometimes the only evidence of early attack. At the point where the beetle enters, usually a small mass of pitch, or a "pitch tube," forms and becomes whitish or reddish in color as it hardens. When the beetle reaches the inner bark, it cuts S-shaped, winding tunnels in the growing tissue between the bark and the wood (figure 2).

The adult beetle carries blue staining fungi (Ceratocystis spp.) which spread into the sapwood and help kill the tree. Lumber cut from infested trees is degraded because of the presence of the fungus. Following attack, pine needles begin to fade and turn yellow. In about one month the foliage becomes brown, and the needles begin to fall. At this time the beetles usually have left, and numerous secondary wood-borers and decay continue the process of rapid deterioration.

The female lays eggs along the S-shaped tunnels. The eggs hatch into tiny larvae which eventually bore into the outer bark. Here they become pupae and transform to young adults (figure 3). As the young beetles emerge, each creates a tiny exit hole in the bark and flies to another tree. The entire period from egg laying to emergence of a new generation of beetles is only 4 to 5 weeks. When conditions are favorable for the beetle, their numbers may increase fivefold to tenfold per generation. Thus, explosive populations may develop in a very short period.

Typically, the insect is sporadic in its behavior, killing groups of trees here and there in the forest. Sometimes an infestation dies out, sometimes it spreads or jumps about in "pop-corn" fashion. Under epidemic conditions, millions of board feet of timber may be killed. When the epidemic has run its course, the insects sometimes disappear as rapidly as they came; in some years it is almost impossible to find any beetles at all.

The first of the three boxes, which is the largest, is made of heavy iron plates, and is covered with a thick layer of lead. It is so constructed as to be proof against fire and theft. The second box is made of lighter material, and is also covered with lead. The third box is made of wood, and is covered with a thick layer of paper. The boxes are arranged in a row, and are each provided with a lock and key. The keys are kept by the Commissioner of the General Land Office.

The boxes are used for the storage of the records of the General Land Office. The records are arranged in alphabetical order, and are numbered in the following manner: 1. The first box contains the records of the first five letters of the alphabet. 2. The second box contains the records of the next five letters. 3. The third box contains the records of the last five letters. The records are kept in this manner for the convenience of the public.

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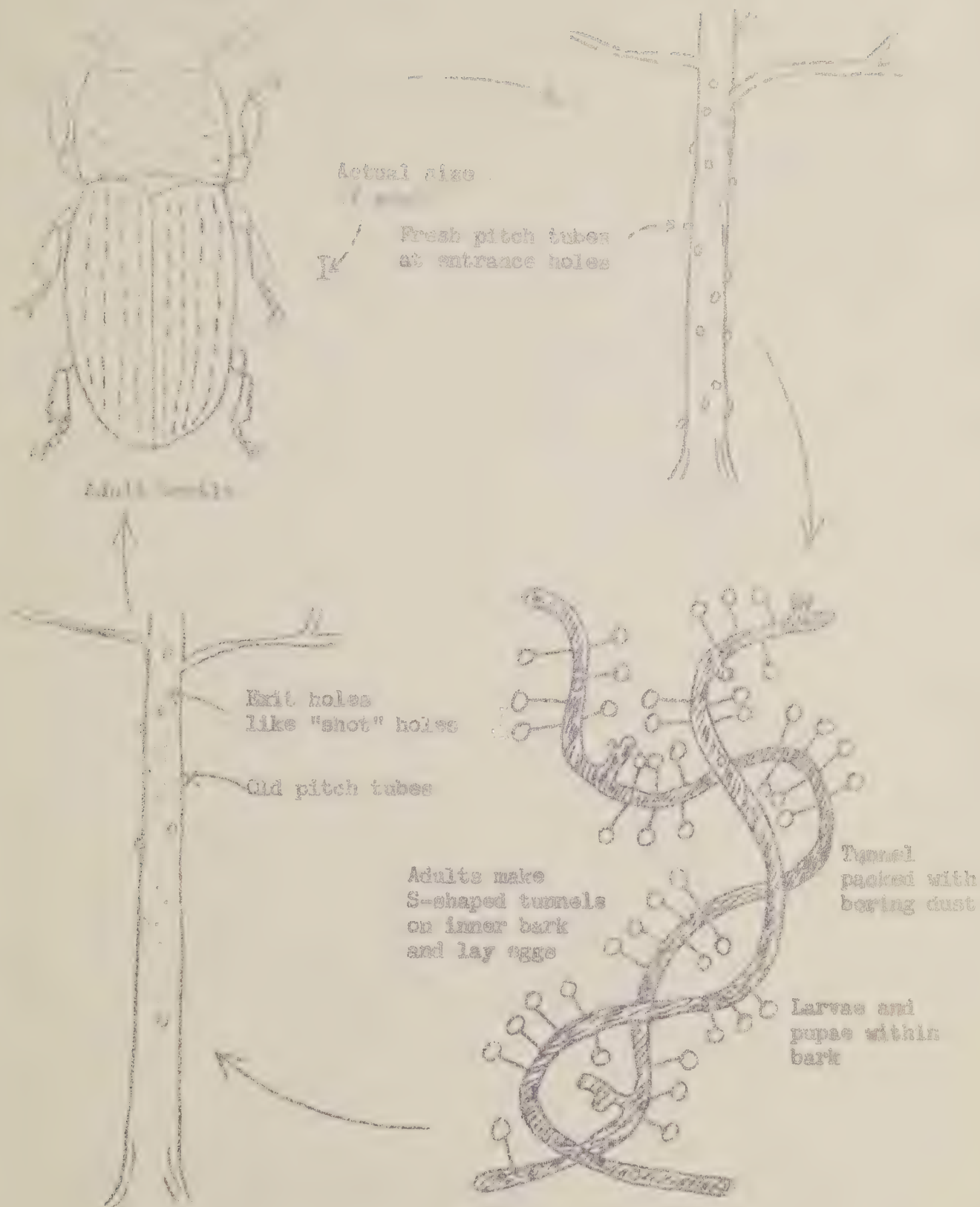


Figure 2. Southern pine beetle.





FIGURE 3. Stages of southern pine beetle: (A) egg, (B) larva, (C) pupa, (D) adult.

LIST OF EQUIPMENT FOR CONTROL PERSONNEL 1/

750 Hard hats
750 Small knapsacks
200 Hunting knives
750 Canteens
200 Pairs of rubber gloves
100 Pairs of shin guards
200 Flashlights or small electric spotlights
125 Pairs of binoculars
125 Compasses
150 Small first-aid kits
25 Photo interpretation outfits
25 Large knapsacks

1/ Prepared by Honduran Government with Assistance of F.A.O.

THE UNIVERSITY OF CHICAGO

CHICAGO, ILLINOIS

DECEMBER 10, 1964

TO THE PRESIDENT

OF THE UNIVERSITY

OF CHICAGO

AND THE FACULTY

OF THE UNIVERSITY

OF CHICAGO

CHICAGO, ILLINOIS

DECEMBER 10, 1964

TO THE PRESIDENT

OF THE UNIVERSITY

CHICAGO, ILLINOIS

DECEMBER 10, 1964

LIST OF EQUIPMENT FOR CONTROL CREWS 1/

90 Power saws with 2 extra chains and spare parts for each
450 3-gallon garden-type sprayers
225 Cant hooks
250 Axes
125 Hand axes
300 Machetes
125 Bow saws
500 Insecticide strainers
1000 Rolls of seismographic tape
3000 Files (flat bastard-type)
5 Files for chain saws
200 15-gallon containers
500 5-gallon containers
200 54-gallon containers
200 2-gallon containers

1/ Prepared by Honduran Government with assistance of F.A.O.

LIST OF EQUIPMENT FOR CAMPS 1/

10 Large tents
225 4-man tents
850 Cots
850 Sleeping bags
25 Generators of 1 kilowatt capacity
40 Camp stoves for cooking
20 Large first-aid kits
30 First-aid kits for vehicles
25 Hand sprayers
Cooking and mess utensils for 850 people

1/ Prepared by Honduran Government with assistance of F.A.O.

1. The first part of the report

2. The second part of the report

3. The third part of the report

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10. The tenth part of the report

11. The eleventh part of the report

12. The twelfth part of the report

LIST OF TRANSPORTATION EQUIPMENT 1/

- 5 2/3-ton trucks
- 5 Jeeps CJ5
- 15 1/2-ton pickups with winches
- 1 Cessna 336
- 3 Large helicopters (16-man plus pilot) 2/
- 2 Small helicopters (3-man plus pilot) 2/

1/ Prepared by the Honduran Government with assistance of F.A.O.

2/ Includes service, maintenance, and operation.

1. *Chlorophyll a* and *b* are the primary photosynthetic pigments in most plants.

2. *Chlorophyll a* is the most abundant and is responsible for the primary photochemical reaction.

3. *Chlorophyll b* is an accessory pigment that transfers energy to *Chlorophyll a*.

4. *Chlorophyll a* is found in the thylakoid membranes of chloroplasts.

5. *Chlorophyll b* is found in the stroma lamellae of chloroplasts.

6. *Chlorophyll a* is a green pigment that absorbs light in the blue-violet and red-orange regions of the visible spectrum.

7. *Chlorophyll b* is a yellow-green pigment that absorbs light in the blue and orange regions of the visible spectrum.

8. *Chlorophyll a* is the most abundant and is responsible for the primary photochemical reaction.

9. *Chlorophyll b* is an accessory pigment that transfers energy to *Chlorophyll a*.

10. *Chlorophyll a* is found in the thylakoid membranes of chloroplasts.

LIST OF COMMUNICATION EQUIPMENT 1/

- 20 Radio telephones (Stoner TCS-2) with frequency of 5,720 k.c. to tie in with Forest Inventory (FAO) radio net (includes 5 mobile sets).
- 125 Portable radios (military type).
- 150 12-volt batteries for Stoner TCS-2.
- 5 Antennas for mobile sets.

1/ Prepared by Honduran Government with assistance from F.A.O.

CONFIDENTIAL

TO: Radio Response (Bureau 202-2) with frequency of
2,750 K.C. to the radio (Bureau 202-2) Radio
not (Bureau 202-2) Radio

Radio (Bureau 202-2) Radio
Bureau 202-2 Radio

LIST OF PERSONNEL CONTACTED

Ministry of Natural Resources

Mr. Salomon Ordóñez, Agr. Engineer. Sub-Secretary
Mr. Antonia Perraza, Agr. Engineer, Director of Agriculture and Livestock
Mr. Douglas Banegas, Agr. Engineer (Entomologist)
Mr. Mario Morillo, Agr. Engineer, Head, Dept. of Plant Sanitation
Mr. Bill O. Santos, Forest Engineer, Director of Natural Resources
Mr. Antonio Lardizabal, Director of Project of Forest Inventory
Mr. Hector Molina Garcia, Minister of Natural Resources

Members of the Committee for the Control of Dendroctonus

American Embassy

Mr. Charles Burrows, Ambassador
Mr. Tom Killoran, Second Secretary
Mr. John Amott, Head, Economics Section
Mr. Peter Constible, Political Officer

F.A.O.

Mr. Arne Haider, Forestry Officer and Project Manager	- Norway
Mr. Caubet, Forest Engineer	- Spain
Mr. Helmut Haufe, Forestry Officer	- Germany
Dr. Charlie Simmons, Soils Specialist	- U.S.A.
Mr. Kees Soels, Associate Forest Expert	- Holland

Armed Forces of Honduras

Major Villanueva, Civil Engineer

Assistance Program for Forest Fire Control

Mr. van Arnsvaldt - Germany

University of Honduras

Prof. Paul Henry Rodriguez, Biologist

A.I.D.

Mr. Edward Brooks, Executive Officer

U.S.D.I. - Bureau of Land Management

Mr. Virgil Heath, Management Specialist

U. S. Army

Major Hammons
Captain Gramly
Major Henson

Aereo Servicios

Mr. Humberto Ochoa, Pilot

ITINERARY

- February 2, 1964 - Bennett and Ketcham traveled to Washington, D.C.
- February 3-4, 1964 - Orientation by A.I.D. and Forest Service.
- February 4, 1964 - (afternoon) Travel from Washington, D.C., to Miami, Florida.
- February 5, 1964 - Travel from Miami, Florida, to Tegucigalpa, Honduras, and orientation at American Embassy.
- February 6-8, 1964 - Orientation and planning meetings with Ministry of Natural Resources and F.A.O. personnel (including flight over part of infested area). Bennett and Ketcham gave lecture illustrated with slides on southern pine beetle control in the United States.
- February 9, 1964 - Orientation trip with Ministry entomologists to southern coast of Honduras.
- February 10-15, 1964 - Collected field data for biological evaluation over epidemic area with Ministry entomologists.
- February 16, 1964 - Began preparation of preliminary report.
- February 17, 1964 - Assisted Ministry entomologists in training of foremen for control crews in Jocón, Department of Yoro.
- February 18, 1964 - Returned to Tegucigalpa and continued work on preliminary report.
- February 19-20, 1964 - Completed preliminary report.
- February 21, 1964 - Discussed preliminary report with officials of Honduran Ministry of Natural Resources.
- February 22-23, 1964 - Bennett traveled to Alexandria, Louisiana, and Ketcham returned to Washington, D.C.
- February 24-25, 1964 - Discussed trip with A.I.D. and U.S.D.A. Traveled to Alexandria, Louisiana, on evening of 25th.

February 7, 1964
TEGUCIGALPA, D. C.
REPUBLICA DE HONDURAS
EL DIA

Diario Libre - Doctrinario - Informativo

MAS DE UN MILLON PARA
DEFENSA DE LOS BOSQUES

Más de un millón doscientos mil lempiras, invertirá el Ministerio de Recursos Naturales en la intensiva campaña que iniciará en breve para combatir la plaga de gorgojo que está destruyendo nues tra riqueza forestal, de conformi dad con un estudio que ha venido realizando dicho Ministerio desde hace más de un mes.

De acuerdo con declaraciones de los funcionarios de Recursos Naturales, la primera etapa de la campaña para la defensa del pino, consiste en extender un cordón sanitario de ciento ochenta kilómetros de longitud, que parte de Arenales en Yoro, hasta cerca de la frontera con Nicaragua, en el departamento de El Paraíso, con el propósito de evitar que el gorgojo que ataca a los árboles pa se a las zonas no afectadas.

En esta primera etapa, que ten drá una duración de seis meses, se estableceran cinco zonas con igual número de sup-zonas dota das de 6 brigadas con seis hombres cada una, las cuales a su vez se integrarán con cuatro hacheros o aserradores para cortar los ár boles afectados, y dos irrigadores de diesel para quemar la corteza de los árboles. En total, se integraran noventa brigadas con seis hombres cada una.

En esta cruzada que se propone el Ministerio de Recursos Naturales, habrá un Jefe de la Campaña que estará asesorado por un Comité que deberá estar integrado por un director, dos asistentes, y tres vocales, en el cual estará representado el Ministerio de Recursos Naturales, las Fuerzas Armadas, el Ministerio de Comunicaciones, el Ministerio de Econo-mía y un asesor forestal de la FAO.

Colaborarán en esta campaña, además, organismos internaciona les, como FAO, OMS, UNSF, ADI, CARE, BID, OIRSA y la Ayuda Bilateral Alemana.

Esta plaga que tiene en peligro nuestra riqueza forestal, se inició en Agalta, Gualaco y Manto en el departamento de Olancho y se ha extendi-do a Jocón, Mangulile y Arenal en Yoro, y amenaza exten derse hacia Comayagua y Francis co Morazan.

Dos doctores entomólogos norteamericanos William Dennett y David Ketchan, del Departamento de Agricultura de los Estados Unidos se encuentran en esta capital, con el objeto de estudiar la plaga que ahora amenaza nues-tros pinos, informó el Ingeniero Salomón Ordóñez, sub-Secretario del Ministerio de Recursos Naturales.

Oficina General de Asesoría Técnica

MADEIRA, 15 DE ABRIL DE 1964

Señor Embajador de Chile en Lima
Lima, Perú

Por medio de la presente se le informa que el día 12 de abril de 1964, el Sr. Ingeniero Salomón Córdova, Sub-Director General de Asesoría Técnica, se reunió con el Sr. Embajador de Chile en Lima, Sr. Carlos Valdovinos, para tratar los temas que se detallan a continuación:

1. Situación actual de la agricultura en Chile.
2. Situación actual de la agricultura en Perú.
3. Situación actual de la agricultura en Ecuador.
4. Situación actual de la agricultura en Colombia.
5. Situación actual de la agricultura en Venezuela.
6. Situación actual de la agricultura en Argentina.
7. Situación actual de la agricultura en Uruguay.
8. Situación actual de la agricultura en Brasil.
9. Situación actual de la agricultura en México.
10. Situación actual de la agricultura en Cuba.

En la reunión se discutió la importancia de la agricultura en el desarrollo económico de Chile y se acordó que el Sr. Ingeniero Salomón Córdova, Sub-Director General de Asesoría Técnica, se reuniría con el Sr. Embajador de Chile en Lima, Sr. Carlos Valdovinos, para tratar los temas que se detallan a continuación:

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Dijo además, que un brote similar surgió en Guatemala, donde lograron controlarlo.

A más tardar en la próxima semana, en Consejo de Ministros se conocerán los planes del Ministerio de Recursos Naturales para empezar a combatir la plaga.

El Ing. Ordóñez declaró para EL DIA, que no se había dado ninguna información al respecto, sino hasta estar seguros que se iba a hacer para detener la plaga en men cion, y por otra parte, para no alarmar a la ciudadanía y no causar perjuicios al país.

Finalizó diciendo que pedía la colaboración de la prensa local, a la que se le informaría en su oportunidad on relación a nuevas etapas de la campaña, que incluye el aprovechamiento de la madera de los pinos que ya fueron atacados por la plaga.

que en este caso, el trabajo es voluntario y no remunerado.

El trabajo voluntario es aquel que se realiza sin recibir remuneración alguna, pero que contribuye al bienestar de la comunidad.

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COMBATE DE PLAGA QUE ATACA NUESTROS PINOS

A raíz del ataque de que son victimas los bosques coníferos de Honduras, por una plaga de gorgojos conocida con el nombre *Dentroctonus*, dos aviones de la Fuerza Aérea Hondureña fueron utilizados temprano del domingo, para transportar a Yoro, 36 guardas forestales, 6 empleados del Proyecto de Inventario Forestal, 3 chilenos entendidos en la materia, 3 periodistas capitalinos, 3 Ingenieros Técnicos alemanes y a los dos co-Directores del Programa de Combate, el Mayor Rubén Villanueva, Oficial del Programa Acción Civica Militar, y el Ingeniero Agrónomo Bill O. Santos, Director General de Recursos Naturales.

En Yoro

Un camión esperaba en el campo de aterrizaje de Yoro a los tripulantes, para conducirlos minutos después al Municipio de Jocón, ya que la pista de aterrizaje improvisada de éste lugar, sólo permite aviones medianos. Antes de viajar hacia Jocón, un hecho de sangre ocurrió en Yoro; el ex-militar Daniel Mejía, en estado de ebriedad, fue baleado por sus antiguos compañeros en una cantina del lugar, y se aprovechó el regreso a Tegucigalpa de las dos unidades de la Fuerza Aérea, después de concluida su misión, para enviarlo a un centro hospitalario tegucigalpense, ya que sus heridas requerían una operación urgente.

Primero: cuatro campamentos

Los Municipios de Jocón, Agua Fria, Mejía y Arenales, fueron los lugares seleccionados para instalar los cuatro campamentos de combate a la plaga, compuestos a su vez, por brigadas cuyos integrantes reciben su primera fase de entrenamiento en aquellos sitios. Con gran rapidez, instantes después del arribo a Jocón, fueron levantadas las casas de campaña, que en número de once dieron cupo a una parte del personal, siendo necesario albergar a los hombres restantes, en el local de una escuela que debido a su mala construcción, la Municipalidad local no ha utilizado.

El ataque inicial

Un cordón sanitario ha sido formado por el Ministerio de Recursos Naturales, para detener un poco el auge que ha venido tomando en fracción de minutos la plaga *Dentroctonus*, que como una línea recta pasa por los departamentos afectados. Tuvo su punto de origen en el Valle de Agalta,

Olancho, des de donde ha invadido con marcada precisión, los bosques coníferos de los otros departamentos El Paraiso, Francisco Morazan y Yoro. El gorgojo Dendroctonus destruye completamente el pino, dejándolo en un estado propicio al incendio.

En la Montaña de "La Flor"

Observando la Montaña de "La Flor" y sus cercanías desde una nave aérea, sobresale la infinidad de partes atacadas por el gorgojo Dendroctonus, constituyendo una diferencia enorme de las partes no afectadas. Ha explicado el lng. Bill Santos, que existe la posibilidad de conseguir el apoyo unanime de los propietarios de bosques privados y de los dueños de aserraderos, para que se logre destruir la plaga que hoy ataca esos valores naturales.

Con fondos alemanes

Este Programa ha sido emprendido utilizando fondos provenientes de la ayuda bilateral alemana a Honduras, no habiéndose recurrido hasta el momento, a dineros del Estado. Se estima que son varios miles de lempiras los que se desembolsarán durante el desarrollo del mismo, ya que sus trabajos comprenden un periodo de seis meses, y se ha hecho necesario ofrecer un regular sueldo a los componentes de las brigadas, en virtud de que trabajarán en riesgo de su salud.

Ayuda de EE. UU.

Temprano del lunes llegaron a Jocón, con procedencia de Tegucigalpa, dos Entomólogos enviados por el Gobierno de Washington, para estudiar la magnitud de la plaga e identificar la especie que esta atacando, para luego recomendar medidas de control.



